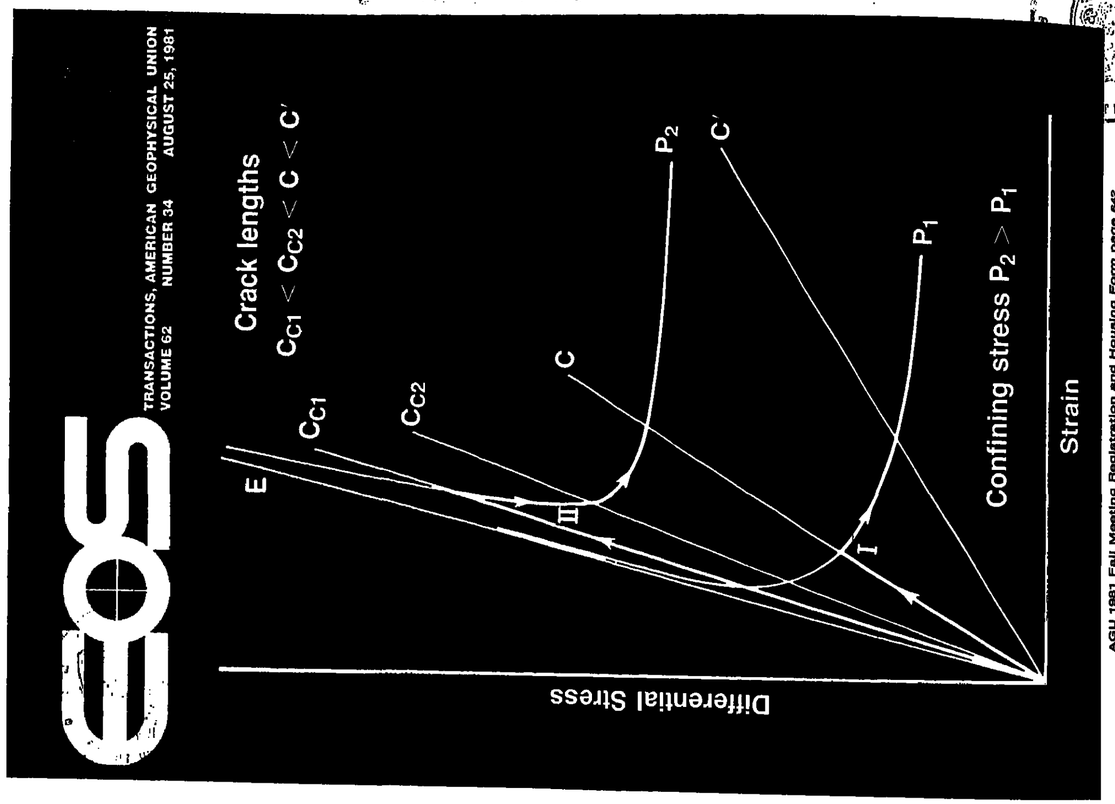

EOS, TRANSACTIONS, AMERICAN GEOPHYSICAL UNION VOL. 62, NO. 34, PAGES 633-648 AUGUST 25, 1981

Editorial

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Fred Spilhaus

EOS

TRANSACTIONS, AMERICAN GEOPHYSICAL UNION

The Weekly Newspaper of Geophysics

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Cover. The AVHRR thermal infrared image (11 μm wavelength) was obtained from the NOAA-6 polar orbiting satellite on December 11, 1980, at 0947 GMT. The image was processed by Richard Legeckis at the National Earth Satellite Service in Washington, D.C. The East Australian Current, one of the five major western boundary currents in the world, appears as a relatively warmer (darker) band of water that is moving southward along the Australian coastline. Near latitude 35°S, the current turns northward in a counter-clockwise loop. Detached meanders and warm core eddies are evident eastward of the current. According to George Cresswell of the CSIRO Marine Laboratories in Australia, the current was surveyed during this period by aircraft, ship, and drifting buoy measurements. Each line of longitude and latitude is 1°. (Photo submitted by R. Legeckis, National Earth Satellite Service, NOAA.)

News

Status of the Grüneisen Constant

As a special workshop at the recent meeting of the International Association of Seismology and Physics of the Earth's Interior (IASPEI) in London, Ontario, geophysicist H. H. Schloessin organized a sequence of discussions on 'gamma,' the thermodynamic parameter first derived in 1926 by E. Grüneisen. The Grüneisen parameter is known to all geophysicists as the less than perfect constant that relates volume and thermal energy properties of a substance in geophysical systems at high pressure, ranging from shock-wave environments to that along the temperature gradient of the earth's lower mantle and core. Derivations and applications of Grüneisen's gamma lean heavily on the fundamentals of quantum and statistical physical theory. The necessary simplicity of the atomic systems for which the scope of the theory applies, and the incredible complexity of its very theoretical basis, have severely limited gamma's practicality for most substances. Furthermore, the geophysical literature is always abreast of the latest cases where a given application of gamma has again failed.

Why, then, does a concept of such apparent tenuity persist? The answer could be made apparent only after considerable esoteric discussion by gamma experts at the IASPEI workshop. New reasons to think gamma is less than constant at high temperature and pressure were provided, as usual. Also, as usual, it was clear that gamma survives again in geophysics, status quo.

Thermodynamically, the Grüneisen parameter is a first-law relationship. Statistically, if the Debye theory assumption that each of the vibrational frequencies of the normal modes of crystals vary in proportion to the inverse gamma (γ) power of the volume, then $\gamma = (d \ln \nu^{max}/d \ln V)$ where ν^{max} is the limiting value of the frequency spectrum of a solid, and V is the specific volume. Translating this to thermal-volume terms, $\gamma = (\alpha V/\beta C_V)$ where α is thermal expansion, $(1/V)(\partial V/\partial T)_P$, β is the compressibility $-(1/V)(\partial V/\partial P)_T$, and C_V is the heat capacity at constant volume. It turns out that many assumptions of both theories are unjustified (for one, contributions of the electronic frequencies of a crystal must be considered as well as thermal frequencies), and the interpretations become complex.

The reason that gamma continues to be so hardy and resistant to heavy criticism is that it appears in many equations of state (i.e. the Mid-Grüneisen equation); it appears in the most valuable equations of state for materials at high temperatures and pressures. Whether gamma is a universal constant or not under the entire range of temperatures and pressures within planetary interiors is not important so long as it can be evaluated within certain structural regimes. Two independent approaches to the theoretical-empirical evaluation of the Grüneisen parameter were described in separate discussions at the workshop by O. Anderson and D. Stevenson. A good portion of the discussion was devoted to analysis of where the approximations were not justified and to equations of state with and without gamma. Nonetheless, the discussions left the concept of gamma better understood and relatively unscathed.

It was appreciated at the workshop that there are several considerations about gamma, whether it is to be evaluated for upper- or lower-mantle conditions or for the liquid or solid core. Aside from deducing gamma from theory and from geophysical data, new methods of measuring gamma of materials in the laboratory were discussed. The quest for gamma of the deep earth's interior continues.—*PMB*

Energy Policy: A Federal Decision

The policies for development of the nation's energy needs for the remainder of this century are being formulated at the highest levels. The Reagan administration has stated consistently that 'energy goals' of the kind Carter proposed for solar power (20% of the nation's energy was to be supplied by renewable resources by the year 2000) will not be set, per se. The role of market forces in setting energy demand and the pace of development and supply will be emphasized. The recent National Energy Policy Plan released by the Reagan administration is a comprehensive statement of how the federal government will restructure its efforts to solve the energy problem. It would appear that fossil fuels will be the mainstay. Federal decontrol and deregulation will be in support of the forces of the market place. Nuclear energy will gain impetus by the deregulation efforts.

At the 'renewable' end of the spectrum, the federal government is not expected to provide large funding support for solar power. Perhaps the largest remaining question is how, and if, the government will support synthetic fuels development. The production of fluids for energy from treated coal and shale oil stocks in the near future will be greatly influenced by an impending decision on the amount of federal support of the Synfuels Corporation.

Fossil Fuels

Over the next two decades the domestic production of oil is expected to remain level, or it may decline at a rate smaller than it would have without price decontrol. Natural gas production is expected to increase after price decontrol, now scheduled to be completed by 1985. Coal is to be the major fuel; domestic use is expected to double over the next two decades. Changes in the regulations on its mining and burning are expected to be a major influence in its increased use.

A crucial factor in the domestic production of petroleum may be the exploration of outer reaches of the continental shelf, onto the continental slopes. Little information is available on how the budget for the Ocean Margin Drilling Program is fareing. What has been made public is the interior Department's desire to sell rights for oil and gas along the entire outer continental shelf regions, an area totaling over 200 million acres.

Nuclear Energy

A turn toward the development of increases in nuclear energy, in the form of more nuclear-powered generators, and in support of basic research in nuclear fusion—at the expense of other types of energy research—has become evident in numerous government statements. Recently at the Senate confirmation hearings for the science advisor post to the president, the nominee, George A. Keyworth, now confirmed, stated that a more favorable circumstance for nuclear energy should develop from the Reagan administration's policy.

Department of Energy research funds are to be stated for basic research projects rather than for development projects that can be done by industry.

Synfuels

The development of synthetic fluids—liquids and gases—from coal and shale oil is tricky and is influenced by oil prices. No matter what the increase in oil prices, the break-even point for economic synfuel development has been elusive. The obvious view that projected break-even points were never realistic is not widely held however. Oil price increases have fired inflation; thus the costs of plant development and construction, and the costs of obtaining the necessary capital, have inflated also. The current belief is that synfuel development needs a boost from industry and the federal government to obtain a foothold in the energy market. Once there, it is thought that synfuels will be competitive. Past fears that continued government backing would allow synthetic fuels to undersell oil are not currently voiced among petroleum companies.

Recently, several petroleum companies—Shell, Exxon, Conoco, and Cities Service—were reported to be among the chief proponents of synfuels for the future (*Chemical and Engineering News*, July 27, 1981). Continuation of the unsettled international political climate through this decade could make synfuels a likely commodity, but not without a rather hefty input of capital. Right now, the government Office of Management and Budget (OMB) is opposed to direct aid for synthetic fuels development. At stake are loan guarantees of several billion dollars and federal price supports of synthetic fuels. Changes of the regulatory procedures of coal mining, of oil shale waste distribution, and of environmental concerns could be important factors.—*PMB*

Consolidation at U. Wash.

The University of Washington Board of Regents has established a College of Ocean and Fishery Sciences. The new college, officially opening on September 1, will comprise the School of Oceanography, the School of Fisheries, the Institute for Marine Studies, the Applied Physics Laboratory, and the Washington Sea Grant Program. The board also appointed D. James Baker, Jr., as acting dean of the college. He has been chairman of the university's oceanography department since 1979.

The Board of Regents also appointed three directors for the college. Donald E. Bevan, appointed director of the School of Fisheries and acting associate college dean, is an adjunct professor of marine studies; he had been dean of the College of Fisheries since 1980 and has been a faculty member since 1959. George C. Anderson, appointed acting director of the School of Oceanography, is a professor of oceanography; he had been associate chairman for research in the oceanography department since 1977 and has been a faculty member since 1958. Warren S. Wooster, appointed director of the Institute for Marine Studies, is professor of fisheries and marine studies and an adjunct professor of oceanography; he has been a faculty member since 1976, and the Institute's acting director since 1979.

Stanley R. Murphy continues as director of the Applied Physics Laboratory (APL); William R. Davis is acting director of the Washington Sea Grant Program and continues to serve as associate director of APL.—*BTR*

The Oceanography Report

H.M.S. CHALLENGER UNDER SAIL, 1874.

The Oceanography Report

The focal point for physical, chemical, geological, and biological oceanographers.

Associate Editor: Arnold L. Gordon, Lamont-Doherty Geological Observatory, Palisades, New York, 10964 (telephone 914/359-2900, ext. 325)

Marine Science and the Law of the Sea

Introduction

Articles about the Law of the Sea Conference and its implications are certainly not among the most popular literature for marine scientists. Unfortunately, however, this conference and the Draft Convention it is now considering may have more impact on marine science than any of our recent discoveries and hypotheses.

The present law of the sea negotiations (more correctly called the Third United Nations Conference on the Law of the Sea or UNCLOS III) officially started in 1973. Over 150 countries are involved in what is easily the most complex series of negotiations ever conducted. Among the important issues are freedom of navigation for military and commercial vessels, environmental protection, resource access and control, and many legal aspects as well as procedures governing marine science in about 40 percent of the ocean. How these meetings evolved, pros and cons of the major issues, and negotiating techniques are discussed elsewhere [see, for example, *Darman*, 1979; *Kronmiller*, 1979; *Breaux*, 1979. *Aldrich*, 1980; *Richardson*, 1980].

A recent development is that the Reagan administration has decided to review all aspects of the Draft Convention to see how it affects various U.S. interests. This review comes at a time when many countries thought that negotiations were almost complete and that only minor points remained for discussion. Regardless of how one feels about a treaty it is fair to say that some aspects, such as deep-sea mining (i.e., nodules) are not too favorable to U.S. interests. Indeed, many would argue that the present Draft Convention has enough flaws in it to prevent its passage by the U.S. Senate. It is very possible that the United States may try for improvements on some issues, which in turn could yield benefits or risks to marine science. It should be appreciated that few countries place the same value on the freedom of marine science research as does the United States. Countries that have tried to protect this freedom include primarily the United States, the U.S.S.R. (until 1976), the Federal Republic of Germany, and The Netherlands, with occasional support from Japan [*Miles*, 1981]. Only the United States and the U.S.S.R. have active ocean-wide research programs, whereas other developed countries usually have regionally based efforts. Before proceeding further, some background is appropriate.

Marine science prior to UNCLOS III was governed by the regulations established in the First Conference on the Law of the Sea, which was held in 1958; this was the first time that marine scientific research was stated in international law. One of the four conventions that resulted from the 1958 Conference—the Convention on the Continental Shelf—said that

> 'the consent of the coastal State shall be obtained in respect of any research concerning the continental shelf. Nevertheless, the coastal State shall not normally withhold its consent if the request is submitted by a qualified institution with a view to purely scientific research into the physical or biological characteristics of the continental shelf, subject to the proviso that the coastal State shall have the right, if it so desires, to participate or to be represented in the research, and that in any event the results shall be published.'

Even this relatively unrestrictive statement eventually caused some problems for marine research [*Kildow*, 1973; *Cheek*, 1973; *Ocean Policy Committee*, 1977]. *Wooster* [1981] recently surveyed the academic, Navy, and NOAA ship operators concerning difficulties for marine research in foreign waters during the 1972–1976 period. He found that in over one fourth of the requests (total of 407), access was denied or inordinately delayed. Prior to and following the first conference and a second one held in 1960, some countries expanded their territorial claims seaward usually also including some control over scientific research. These extended claims, sometimes reaching out to 200 nautical miles, and the anticipation of new marine resources were among the factors leading to UNCLOS III.

UNCLOS III negotiations have produced several iterations of a potential treaty. The most recent one, referred to as the Draft Convention on the Law of the Sea, has been treated as being close to, if not almost, the final document. Although small revisions have been made over the years to the marine scientific research articles, the basic conditions for research in the territorial sea, the exclusive economic zone (EEZ), and the remaining regions of the ocean are fairly clear. Some argue that the conditions are already part of international law. The new regime for the ocean will, without a doubt, change the way in which marine scientists and marine scientific research operate. The Draft Convention will restrict many activities of U.S. marine scientists, but it may also offer certain opportunities.

An important point in assaying the impact of UNCLOS III on marine science is whether science would be better served without a treaty. It is easy to conclude, however, that although the Draft Convention is not very good for marine science, it is, because of other events, better than no treaty. The reason for this apparently contradictory statement is that as of February 1981, 88 coastal states have already declared some kind of a 200 nautical mile zone out of a total of 135 coastal states. In addition, 69 of these states either specifically or indirectly claim jurisdiction over marine research in their 200 mile zone [M. H. Katsouros, personal communication, 1981]. With the demise or absence of a treaty, it seems reasonable that the remaining countries will also adopt at least a 200-mile zone. It is also reasonable to assume that the conditions for marine scientific research, without a treaty, will be at least as restrictive as those in the present Draft Convention. These rules would probably differ from country to country and will present a potential administrative quagmire for the U.S. Department of State and, thus, also for the U.S. marine scientists and administrators who will need the State Department for information and permission to do research. Another point is that continuing extension of states' claims farther into the ocean and additional rules for marine science are less likely once a treaty is in place than without one since a treaty will define and limit most jurisdiction.

The general review of the Draft Convention initiated by the Reagan Administration could have an impact on marine scientific research. If the United States decides to withdraw from further negotiations, it is hard to imagine that the science articles could be improved (since the United States is the principle country concerned with marine science in a positive sense), and indeed they could get worse. If the treaty negotiations were to fail because of the United States' withdrawal, scientific research could suffer if countries attempted retribution against the United States for its perceived role in spoiling the conference. If the United States continues in the conference but puts its emphasis in obtaining better conditions for deep-sea mining, some scientific benefits could be negotiated away. Another possibility is that the United States, in its review, decides that improvements in the marine scientific research articles are important and, in some manner, successfully negotiates improvements.

The Law of the Sea negotiations establish several new zones in the ocean and redefine some old ones (Figure 1) within each there are conditions for marine scientific research. The principle zones for marine science are internal waters, territorial sea, straits, archipelagos, exclusive economic zone (EEZ), continental shelf beyond 200 miles, and the 'Area.' A brief description of the new marine scientific regime for each region follows.

Specific Regions

Internal Waters

Coastal states, under the Draft Convention, have complete sovereignty over activities within their internal waters. These waters include rivers, bays, lakes, and other areas on the landward side of the baseline from which the territorial sea is delineated. There are only slight changes from the 1958 Convention on the Territorial Sea and Contiguous Zone, mainly in the methods by which the baseline is measured.

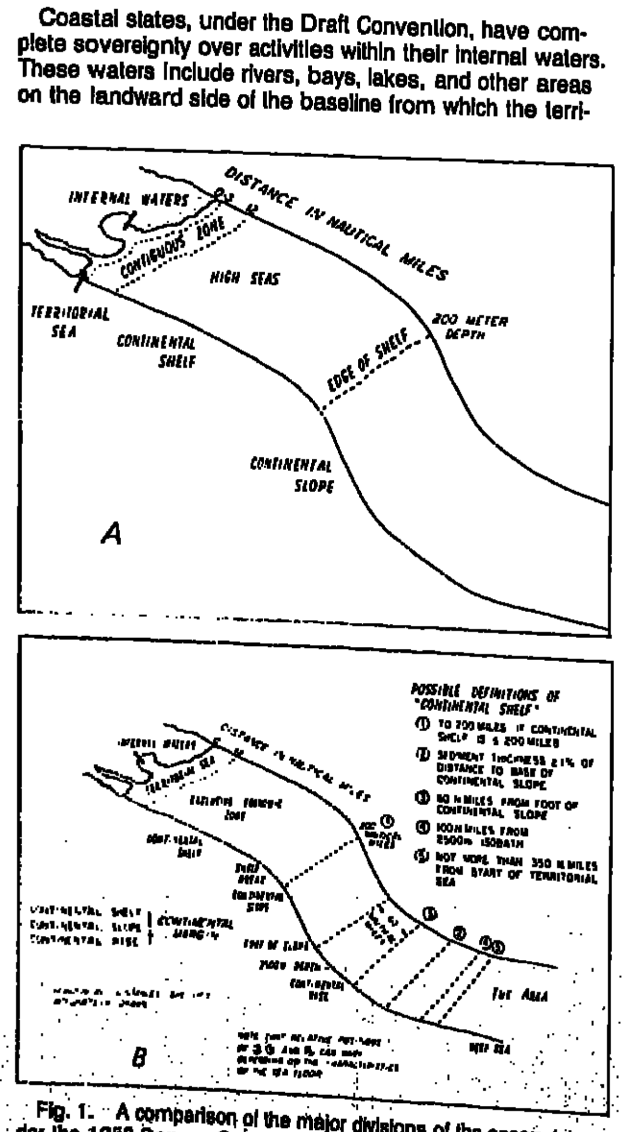

Fig. 1. A comparison of the major divisions of the ocean (*a*) under the 1958 Geneva Convention and (*b*) under the Draft Convention (see text for further details).

Territorial Sea

The Draft Convention establishes a territorial sea, 12 nautical miles wide, a point that essentially is now an established principle in international law. This, ironically, could actually be an advantage to some scientific work. The U.S. State Department, at present, recognizes only a 3-mile-wide territorial sea; thus, a U.S. researcher has a problem if he or she wants to work, say, 100 miles off a country that has declared a 200-mile territorial sea. In this fairly common situation, the U.S. State Department generally would not make the permission request, since to do so would be a tacit acceptance of that country's claim. Alternatives for a researcher are to request permission to work within 3 miles of the coast (in which case the U.S. State Department could ask for permission) and actually to conduct the research there (and at 100 miles) at an increased cost to the project or to avoid the problem and work outside of 200 miles. With an internationally accepted 12-mile territorial sea and the protection afforded to the coastal state by the EEZ (see next section), some of the diplomatic problems associated with various territorial sea claims should be eliminated. This is not a small point, since, as of May 1981, 80 states claim a 12-mile territorial sea, 25 claim more than 12 miles (14 of these claim 200 miles), and only 28 states claim less than 12 miles (Office of the Geographer, U.S. Department of State). The Draft Convention, if accepted, should eliminate claims of more than 12 miles for a territorial sea.

Within the territorial sea the coastal state has 'the exclusive right to regulate, authorize and conduct marine scientific research, . . . [which] shall be conducted only with the express consent of and under the conditions set forth by the coastal State' (Article 245).

Although coastal states have sovereignty over the territorial sea, there is a right of innocent passage. However, 'the carrying out of research or survey activities' is eliminated as an accepted activity under innocent passage. Thus the control over marine scientific activities in a well-defined territorial sea are clear. However, no statements are made concerning the mechanisms necessary to get permission or the conditions that a coastal state can impose on a researching state or institution if they want to work in a country's territorial sea. Presumably, such arrangements would be made on an ad hoc basis.

Straits

The international acceptance of a 12-mile-wide territorial sea will affect many previously international straits. One hundred and sixteen straits are more than 6 but less than 24 miles wide and would now be included within the territorial seas of the adjacent states [*U.S. State Department*, 1974]. Article 40 in the Draft Convention says that 'foreign ships, including marine scientific research and hydrographic survey ships, may not carry out any research or survey activities without prior authorization of the States bordering straits.' This restriction could make it very difficult to conduct research in such straits, in part because usually two or more states will have to give permission. Straits between major bodies of water (Bab el Mandeb or Gibraltar, for example) are obviously important and interesting areas for study. A further complication concerning strait research is the absence of statements concerning the mechanisms for getting permission to do research and the restrictions or conditions that a coastal state can place on the research. Implied consent, which exists in the EEZ, does not extend to research in straits where the unclear conditions and mechanisms of the territorial sea apply.

Archipelagos

A series of articles in the Draft Convention will permit island states to define baselines for archipelagic waters. The actual extent of these waters is not clear, and definition probably awaits jurisdiction. What is clear is that the island state will have territorial sea rights over its archipelagic waters for scientific research.

Exclusive Economic Zone

The exclusive economic zone or EEZ is a new concept and presents a major problem for marine science. It extends 200 nautical miles (370 km) from the baseline from which the territorial sea is measured (Figure 1*b*). Thus, it includes all the coastal waters of the world and most of the continental shelves (in the geological sense). It encloses (with the territorial sea) about 32% of the ocean (Figure 2). Prior to UNCLOS III much of this area was open to many forms of marine scientific research. The conditions for marine scientific research in another country's EEZ are consent with numerous requirements. The important aspects are as follows:

1. Consent is necessary and 'shall in normal circumstances' be granted (Article 246, part 2). It can be denied if the project (*a*) 'is of direct significance for the exploration and exploitation of natural resources, whether living or non-living; (*b*) involves drilling into the continental shelf, the use of explosives or the introduction of harmful substances into the marine environment; (*c*) involves the construction, operation or use of artificial islands . . .; (*d*) contains inaccurate information 'or if the researching State or competent international organization has outstanding obligations to the coastal State . . .' (Article 246, part 5). A coastal state's decision based on the above provisions is not reviewable by a third party.

2. Specific information must be supplied not less than 6 months before the start of the project. This includes (*a*) 'the nature and objectives of the project; (*b*) the method and means to be used, including name, tonnage, type and class of vessels and a description of scientific equipment; (*c*) the precise geographical areas in which the project is to be conducted; (*d*) the expected date of first appearance and final departure of the research vessels, or deployment of the equipment and its removal, as appropriate; (*e*) the name of the sponsoring institution, its director, and the person in charge of the project and (*f*) the extent to which it is considered that the coastal State should be able to participate or to be represented in the project' (Article 248).

3. Specific conditions must be met. Applicants asking for consent to conduct research must (*a*) 'ensure the right of the coastal State, if it so desires, to participate or be represented in the marine scientific research project, especially on board research vessels . . .'; (*b*) provide preliminary and final reports; (*c*) provide access for the coastal State to all data and samples from the project and 'furnish it with data which may be copied and samples which may be divided without detriment to their scientific value'; (*d*) provide, if requested, 'an assessment of such data, samples and research results or provide assistance in their assessment or interpretation'; (*e*) ensure 'that research results are made internationally available through appropriate national or international channels'; (*f*) 'inform the coastal State immediately of any major change in the research programme' (Article 249).

4. 'Communications concerning the marine scientific research projects shall be made through appropriate official channels unless otherwise agreed' (Article 250). These channels probably are foreign ministries and the U.S. Department of State which surely will lessen the role of scientist-to-scientist relationships that so often have been successful in developing projects.

5. Coastal states can suspend research activities if (*a*) it is 'not being conducted in accordance with the information communicated' (i.e., information requested in Article 248) or if the conditions specified in Article 249 are not met; (*b*) there is a major change in the research project or activities (Article 253).

6. After permission to conduct research is granted, land-locked and geographically disadvantaged States in the region may request to receive the information provided under points 2 and 3, above. These states may also participate, when feasible, in the project through qualified experts, although the coastal state can object to the choice of expert.

Notwithstanding the foregoing conditions, consent is implied, and the researching state or organization may begin research 6 months after submitting its request if the coastal state has not denied consent within 4 months after receiving the information specified in Articles 248 and 249. However, the coastal state can ask for additional information and postpone, almost indefinitely if it desires, a decision. Therein lies one of the biggest problems of the Draft Convention: the lack of predictability concerning a cruise.

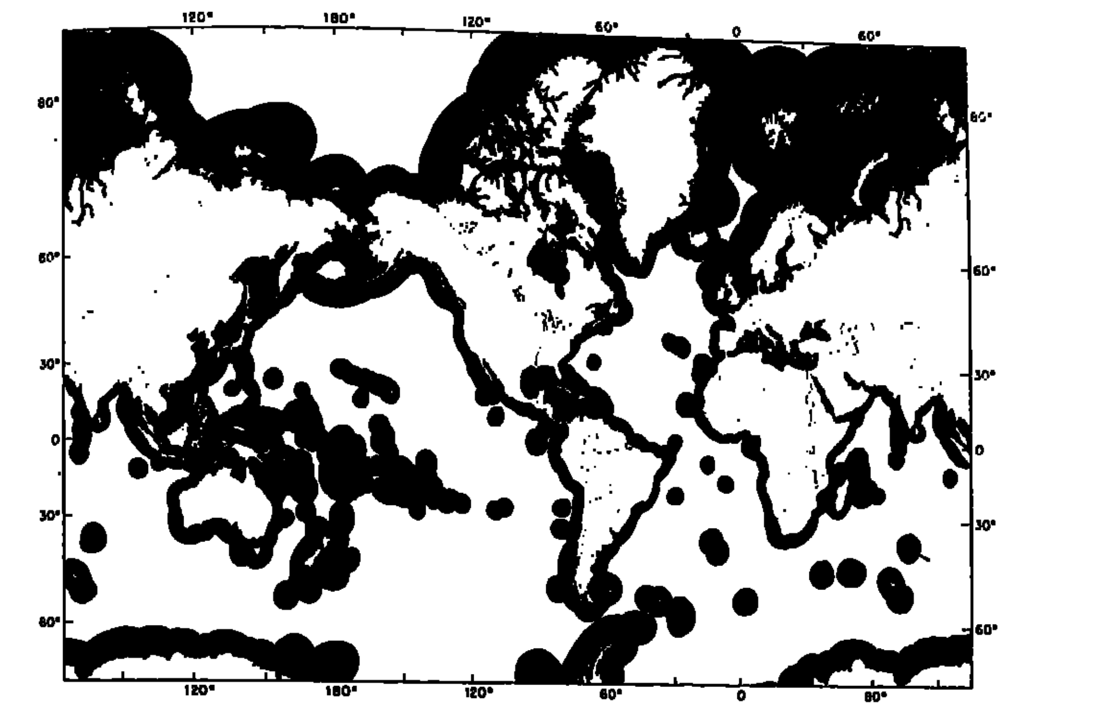

Fig. 2. The area of the ocean covered by a 200-nautical mile Exclusive Economic Zone (EEZ). Note that this is a Mercator projection and that the size of the polar regions is exaggerated [from *Ross*, 1980].

Continental Shelf Beyond 200 Miles

The continental shelf in the Draft Convention has a complex definition (see Figure 1*b*) that extends it to a distance of 200 nautical miles (i.e., coterminous with the EEZ), if the continental margin (shelf, slope, and rise) does not extend to 200 nautical miles. If the continental margin extends beyond 200 nautical miles, several definitions come into play based on the thickness of the sedimentary rocks (how this thickness is determined is not stated) or distance from shore, but, in any case the limits of the continental shelf shall not exceed 350 nautical miles from the territorial sea baseline or 100 nautical miles from the 2,500 m isobath. The exact areal extent of this region cannot be determined at this time, but it is thought to be about 6–8% of the ocean. The provision concerning sediment thickness for delimitation certainly will permit confusion and allow for excessive claims.

All the marine scientific conditions mentioned above for the exclusive economic zone also apply to the Continental Shelf except that a coastal state may withhold consent only in specific areas that it has publicly designated as subject to exploitation or detailed exploratory operations within a reasonable period of time. In addition, research in the water column beyond the limits of the EEZ is permitted.

'The Area'

The region outside of coastal state jurisdiction is defined in the Draft Convention as the Area (i.e., the remaining 60% or so of the ocean). Basically, there are no significant restrictions in the Draft Convention concerning marine scientific research in the Area. However, there is a provision for a review conference to be held 15 years after commencement of commercial production of mineral resources (nodules) from the Area that could have the potential for mischief. A suspicious mind could imagine freedom of marine scientific research being regarded as a negotiating chip that might be surrendered by the United States or other developed countries in return for assured and continuing access to ocean minerals. If ocean thermal energy conversion (OTEC) is found to be a successful source of energy, regulations concerning the water column could also be developed.

The Draft Convention does say that 'states and competent international organizations shall promote and facilitate the development and conduct of marine scientific research in accordance with this Convention' (Article 239) and that coastal states should 'endeavour to adopt reasonable rules, regulations and procedures to promote and facilitate marine scientific research . . . beyond their territorial sea and to facilitate . . . access to their harbours and promote assistance for marine scientific research vessels' (Article 255). Although these statements are valuable, they are not binding.

Publication Problems

A major general concern for science in the Draft Convention is publication rights and the flow of scientific data. Article 249, paragraph 2, requires 'prior agreement for making internationally available the research results of a project of direct significance for the exploration and exploitation of natural resources.' This is a confusing statement since Article 246, paragraph 5a, allows coastal states to withhold permission for research in their EEZ or on their continental shelf beyond 200 miles if the project is 'of direct significance for the exploration and exploitation of natural resources, whether living or non-living.' A difficulty for open publication is that almost any type of marine research could have some relevance to resources, and such an interpretation during or after the work could affect publication rights. It should also be repeated that the coastal State has complete discretion to determine what research is of direct significance for resources, and thus it is possible for a coastal state to deny consent for almost any type of marine research. This is a major change from the 1958 convention where open research was encouraged.

Implications and Recommendations

The above conditions clearly indicate the need for changes by U.S. marine scientists, institutions, and funding organizations in their manner of operation. Many of the articles mentioned above have pitfalls, and clearly any foreign country that wishes to refuse or delay a project should have no trouble finding a justification. Alternatively, if a country supports the research, the detailed requirements may become merely administrative tasks, except probably for foreign participation in research and sharing of data. These latter two items and others could involve additional costs beyond that of the initial project. As a coastal state can deny a research request from a country if there are outstanding obligations against a previous project by that country, how and when a research project ends should be clearly defined in early negotiations. The previously mentioned problems for publication is important and should also be reconciled in early stages of negotiation. The point that research activities can be suspended if there is a major (undefined) change in the project also poses potential difficulties. Changes can occur owing to ship breakdown, loss of equipment, weather problems, or adjustment of cruise tract or objectives in accordance with scientific information gained during the cruise. A coastal state will, under the Draft Convention, have the ability to affect or stop a project in almost any phase of its activity.

Once (or if) the Draft Convention is opened for ratification there might well be a transition period of several years before it is approved. During this period the U.S. State Department might either follow the present U.S. position on various issues (such as the 3-mile territorial sea) or the Draft Convention. Either situation could present potential for confusion, unnecessary delays, rejections, or avoidance of research requests. (Similar and perhaps more complex problems are possible if the United States withdraws from the treaty negotiations or if a treaty fails.)

Two indirectly related aspects may cause a reduction in U.S. marine science efforts within foreign EEZs. The first is that scientists and institutions just may avoid working in certain areas because of anticipated or past difficulties in conducting research there. This may already be seen in the general avoidance of waters off Trinidad and Tobago, India, and the Soviet continental shelf. By such avoidance, we can make the problems of the Draft Convention come true without even trying. Second, our own government may require a stricter adherence to the Draft Convention than individual countries might impose. In addition, having to deal through official channels could discourage many individual scientists. As marine scientists we should be prepared and willing to test and, if necessary, even challenge strict or arbitrary interpretations to see if we can work out agreeable arrangements, such as bilaterals [see *Open Policy Committee*, 1981] rather than letting activities overtake us.

For U.S. marine science and marine scientists to continue their future research activities in the world ocean certainly will imply additional administrative and funding considerations. Perhaps most important is that the development of foreign programs will require more time and impose additional costs. The necessity of having at least a 6-month lead time to get permission has implications for grant approval by organizations like the National Science Foundation and the Office of Naval Research, which tend to operate on a 1- or 2-year financial calendar.

Concern and opportunities should be established for preliminary meetings between U.S. and foreign scientists and administrators for the development of joint programs as well as to increased support for U.S. scientists to participate in international meetings such as the Intergovernmental Oceanographic Commission (IOC). Perhaps a separate funding source should be established and used to explore and discuss possibilities for foreign programs. The importance of participating in international organizations like the IOC stems from Article 247 of the Draft Convention, which provides a mechanism by which such organizations can get consent for projects in the waters of member states.

Funding organizations and research institutions will have to be aware of the conditions on marine research under the new ocean regime and recognize that training of foreign scientists, data evaluation, and the like will be common components of research projects. Scientists, especially young ones, should not be penalized by participating in such activities even though it will divert them from their prime scientific objectives. Large or active institutions should consider the establishment of a foreign office that can help their scientists, administrators, and the funding agencies in developing and keeping track of foreign activities. It would be naive to think that the average scientist could wander through the potential maze of regulations imposed by the Draft Convention without any help and come out many years later with an administratively, scientifically, legally, and internationally satisfactory program, and be willing to try it again. On the other hand, the U.S. State Department, funding agencies, institutions, and individual scientists should be able to survive and even thrive in this new regime if we work together.

Acknowledgments

Many of the thoughts expressed in this note have evolved from discussions with my colleagues on the Freedom of Ocean Science Task Group of the Ocean Policy Committee of the National Academy of Science. In particular, I would like to acknowledge William T. Burke, John V. Byrne, John P. Craven, Paul M. Fye, Mary Hope Katsouros, John A. Knauss, Edward L. Miles, Roger Revelle, Manik Talwani, and Warren S. Wooster but am not implying that they agree with everything I have said. Support for writing this note has come from the Department of Commerce, NOAA, Office of Sea Grant under grant NA80AA-D-00077 and the Pew Memorial Trust.

Note From the Associate Editor

This is the first installment of the Oceanography Report [illegible]

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Opinion

Figure 2 of Ross' article, 'Marine Science and the Law of the Sea,' is the conventional illustration of the 'Exclusive Economic Zone' that would be established by a 200-mile limit. A more realistic view of the impact is obtained by plotting the 200-mile limit on an equal area projection. The above map is an oblique Hammer equal-area projection with interruptions such that the world ocean is shown as a unit. (Figure from Atheistan Spilhaus, Middleburg, Virginia.)

Information Reports

Special Sessions Headline Fall Meeting

Two special sessions have been added to the oceanography roster for AGU's Fall Meeting, bringing the total of special oceanography sessions to 14, according to Barbara Hickey, Fall Meeting program chairman for oceanography.

The Fall Meeting will be held in San Francisco from December 7 to 11; the deadline for abstracts is September 16. Details for submission of abstracts were published in the June 30 issue of *Eos*.

A session on MARSEN (Marine Remote Sensing Experiment) is one of the new additions to the meeting. MARSEN, an international collaborative experiment, was conducted in the North Sea between August and November 1979, reports Omar Shemdin at the Jet Propulsion Laboratory (JPL). The experiment explored the application of remote sensing techniques to detect surface waves, wind, current, and surface expression of oceanic fronts, and to understand better depth-limited oceanic processes. For additional information, contact Omar Shemdin at JPL, Mail Stop 183-501, 4800 Oak Grove Drive, Pasadena, CA 91103 (telephone: 213-354-2447).

The second new session will review the POLYMODE Local Dynamics Experiment, which was designed to observe mesoscale eddy processes in the southern part of the Gulf Stream Recirculation region. The program included velocity, temperature, salinity, and oxygen profiling, current meter moorings, and SOFAR floats. Most of the material in the session has never been presented to a broad audience. Included on the agenda are principal descriptive results of the experiment and preliminary dynamical interpretation of the mesoscale processes that occurred during the experiment. Additional information can be obtained from Bruce Taft, PMEL-NOAA, 3711 15th Avenue, N.E., Seattle, WA 98105 (telephone: 206-543-7129).

An AGU session on Marginal Ice Zone (MIZ) Processes also is on the agenda for the Fall Meeting. The session is particularly appropriate at this time, notes contact Robin Muench of SAI/Northwest, because a major international program (the Marginal Ice Zone Experiment, or MIZEX) is in the final planning stages; field activities are scheduled to commence in 1983. The session will provide an excellent forum for updating and synthesizing results from the increasingly active MIZ-related programs. In addition, the session will provide valuable input for MIZEX. Session topics will include oceanic, atmospheric, and sea-ice processes that relate to the MIZ and regional aspects of the results. An invited overview presentation will be made by Ola Johannessen of the University of Bergen, Norway. Seelye Martin of the University of Washington in Seattle will present a contributed talk on the formation of ice factors along the MIZ. For additional information, call Robin Muench, the session chairman, at 206-747-7152.

A session on HEBBLE (High-Energy Benthic Boundary Layer Experiment) also will highlight the meeting. HEBBLE is an integrated, multidisciplinary deep ocean program funded by the Office of Naval Research. The scientific goal of this effort, according to Charles Hollister at Woods Hole Oceanographic Institution and project director, is to quantify the magnitude of deep-ocean currents and their temporal and spatial variability and to predict the response of the cohesive, biologically altered sediment to the imposed stresses. The long-term goal is to formulate and field-verify a predictive sediment-transport model for cohesive material in high-energy areas. The session is timely, according to Hollister, because it follows a very exciting 1981 field session in the North Atlantic. For additional information, contact Charles Hollister at WHOI, Woods Hole, MA 02543 (telephone: 617-548-1400, ext. 2200).

Papers to be presented at the MANOP (Manganese Nodule Project) session will present some of the most recent work done in the project, which studies the processes that control the distribution and composition of deep-sea ferromanganese nodules. Through a series of integrated experiments, MANOP is attempting to identify the sources and fluxes of transition metals to the sediment-water interface. MANOP is also attempting to resolve the partitioning of the elements between particulate debris, bottom and pore waters, and nodule and sediment phases at a small number of 'type' Pacific deep-sea environments. For additional information, contact Jack Dymon at the Oregon State University, Corvallis, OR 97331 (telephone: 503-754-2296), or Paul Dauphin, University of Rhode Island, Kingston, RI 02881 (telephone: 401-792-6127).

Other special sessions and their contacts (and telephone numbers) are listed below.

West Coast Circulation: Bob Beardsley (617-548-1400, ext. 2536); *Verne Channel: Hydrography, Geochemistry, and Sediment Dynamics:* Pierre Biscaye (914-359-2900) or Dave Johnson (617-548-1400, ext. 2463); *Hawaii-Tahiti Shuttle Experiment* and *Mid-Latitude Large-Scale Variability:* Dave Cutchin (714-452-3226); *Dynamics of Coastal Circulation Over Topographic Features:* Phil Hsueh (904-644-2525); *Coastal Oceanography* and *Paleo-oceanography:* Barbara Hickey (206-543-4737); *Estuarine Processes—Physical, Chemical, and Biological:* Dave Peterson (415-323-8111); *SANDS (Shelf and Nearshore Dynamics of Sedimentation):* Chuck Nittrouer (919-737-3711); *Southern Ocean Studies:* Worth Nowlin, Jr. (713-845-2947).—BTR

Ocean Drilling Reorganized

The National Science Foundation has combined its proposed Ocean Margin Drilling Program (OMPD) with the existing Deep-Sea Drilling Program (DSDP). This reorganization calls for the retirement in 1983 of DSDP's mainstay, the *Glomar Challenger*, which is nearing its 14th year of operation. The *Glomar Explorer*, the former CIA ship, with 5 times the carrying capacity of the *Challenger*, will become the sole NSF drilling ship.

Engineering and science planning for OMDP will continue largely unchanged with the new plan, though the schedules for achieving some scientific objectives may change, according to the Joint Oceanographic Institutions, Inc. (JOI), a consortium of 10 academic oceanographic institutions. Additional industry and foreign support will be sought under the new plan.

Reaction from the academic community has been positive. Response from the petroleum industry, which shares with NSF the cost of OMDP, is mixed, but understandably so; the reorganization will delay by several years drilling along the passive ocean margins that could lead to the discovery of oil and gas deposits.

Although the details of the plan have yet to be hammered out, the first phase of the *Explorer*'s conversion is expected to begin in fiscal 1983 and to continue into fiscal 1984. Launch of the newly outfitted *Explorer* is anticipated in middle-to-late 1984, according to Allen M. Shinn, Jr., director of the new Office of Scientific Ocean Drilling; the office was created by NSF Director John Slaughter in early August to smooth the merger transition. Shinn, formerly senior science associate to Slaughter, noted that there will be no drilling for 6 months to 1 year.

Refurbishment of the *Explorer*, now mothballed in Suisun Bay (north of San Francisco, Calif.), will give the ship drilling capabilities similar to those of the *Challenger*. Two to three years later, the *Explorer* will go back to the yard for a second conversion to add riser and well-control technologies, which make possible drilling on the passive ocean margins by controlling the pressures encountered if the drill accidentally strikes hydrocarbon deposits.

Changes in the drilling program were spurred by a lack of consensus on the scientific objectives for ocean drilling, Shinn told *Eos*. The *Explorer*, when it is ready, will allow the scientific community to set goals without the physical constraints of the working drill platform, he explained. Additional impetus came from the tightening of the federal monseybell. 'It's clear that NSF can't consider operating 2 ships,' said Shinn. Operation costs for the *Challenger* are about $25 million (1981 dollars) per year; when the *Explorer* goes into operation, its costs would equal about $40 million (also 1981 dollars), excluding rehabilitation costs.

Shinn reports that the academic community's response has been positive. In addition, the executive committee of the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES), an international organization of advisory panels and committees, met in Germany the week of August 10 and unanimously agreed that putting the two programs together was a good idea. Informal responses from foreign nations also have been optimistic, Shinn said.

Petroleum industries, though, are more reluctant to give the plan hearty approval. The 10 oil companies that agreed last year to match funds with NSF to finance OMPD first heard about the reorganization at a July 22 meeting with John Slaughter in Houston. J. B. Coffman, vice president for exploration at the Exxon Production Research Co., stressed that Exxon has not completed its analysis nor adopted an official position on the new plan. He did say, however, that he thought it was good for the government's program direction to have one research vessel. Even so, Coffman is unsure of the cost effectiveness of the program. Fewer holes will be drilled with the riser technology, and, although this will reduce the bottom-line cost, the cost per well drilled will be higher in the new plan when the conversion costs for the *Explorer* are considered, he told *Eos*.

Ten other petroleum companies were invited to participate in the ocean drilling program, and they attended the Houston meeting.

NSF expects to supply the oil companies with a detailed conversion plan in June 1982, Shinn said, which will include an integrated science plan for the *Explorer*, an operation and control management plan, and detailed designs and cost estimates for the ship's conversion.—BTR

Announcements

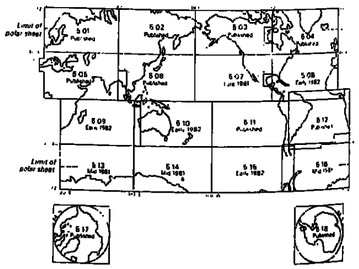
Bathymetric Charts Near Completion

The fifth edition of the 'General Bathymetric Chart of the Oceans' (GEBCO), the series of bathymetric charts that originated at the Seventh International Geological Congress in Berlin in 1899, will be complete soon.

Thirteen of the final 18 charts that cover the world are available. The last chart should be complete next May. All of the charts have a scale of 1:10,000,000; polar sheets are 1:6,000,000.

Guiding the chart production is a joint committee of marine geologists and geophysicists from the International Hydrographic Organization and the Intergovernmental Oceanographic Commission of UNESCO. Cartographic production of the sheets is undertaken by the Canadian Hydrographic Service in Ottawa. The basic project, grid, and land work is taken from the Carte Generale du Monde by permission of the Institut Geographique National in France.

Sheets are available at $5.00 (Canadian) plus handling charges from Hydrographic Chart Distribution Office, Department of Fisheries and the Environment, 1675 Russel Road, P.O. Box 8080, Ottawa, Canada K1G 3H6.



NOAA Starts Oceanography Publication

A new NOAA publication entitled *Oceanographic Monthly Summary* began in January. The publication, edited by Steve Auer, replaced two other NOAA periodicals, *Gulfstream* and *Fishing Information*, and it will attempt to disseminate the monthly oceanographic information in a more timely and efficient manner than did the other two publications.

Oceanographic Monthly Summary contains 15 sea surface temperature (SST) analyses, 3 oceanographic thermal feature analyses, and a Bering Sea/North Slope Ice analysis. The SST analyses include monthly means, anomalies, and yearly changes for the Atlantic and Pacific oceans and the Gulf of Mexico in both 2° and 1° latitude/longitude scales. The ocean feature analyses show and describe the monthly activity of the Gulf Stream system and its associated eddies for the northwest Atlantic and Gulf of Mexico as well as other observed thermal features for the western U.S. coast. The Bering Sea/North Slope Ice analysis describes sea ice age, thickness, and coverage for the area.

The National Weather Service and the National Earth Satellite Service jointly sponsor the publication.

JGR on Seasat

A special issue of the *Journal of Geophysical Research* will be devoted to scientific results from Seasat in the disciplines of oceanography, meteorology, geodesy, and geology. Individuals who have presented results in the Seasat sessions at the AGU 1981 Spring Meeting are encouraged to submit manuscripts for this issue. However, any papers describing scientific investigations that use Seasat data in the aforementioned disciplines are welcome. To aid in planning this issue, please inform George

Born of the tentative title of your manuscript by October 1, 1981. Authors are encouraged to submit manuscripts as soon as possible but no later than December 1, 1981. Standard JGR review procedures will be followed.

Geodesy and glaciology manuscripts should be sent in quadruplicate to Thomas J. Ahrens, Seismological Laboratory 252-21, California Institute of Technology, Pasadena, CA 91125.

Manuscripts in other disciplines should be sent in quadruplicate to A. D. Kirwan, Jr., Department of Marine Science, University of South Florida, 830 First Street South, St. Petersburg, FL 33701.

In addition, please send one manuscript copy to George H. Born, Jet Propulsion Laboratory, M/S 264-737, 4800 Oak Grove Drive, Pasadena, CA 91109.

Meetings

Ocean Hydrodynamics Colloquium

The 14th International Colloquium on Ocean Hydrodynamics will be held at the University of Liege, Belgium, May 3–7, 1982. The subject will be 'Marine Hydrodynamics of the Equatorial Ocean,' with emphasis on theoretical oceanography.

Members of the Organizing Committee are Jacques Nihoul, Jens Meincke, David Anderson, Dennis W. Moore, James J. O'Brien, and S. G. H. Philander. Those who wish to present papers should contact Dennis Moore at JIMAR, University of Hawaii, Honolulu, HI 96822, or Jacques Nihoul at Geophysical Fluid Dynamics, University of Liege, Belgium. Nongovernment U.S. participants may contact Jan Witte at Nova University Oceanographic Center, 8000 North Ocean Drive, Dania, FL 33004, for possible travel support.

New Publications

Descriptive Regional Oceanography

P. Tchernia, *Pergamon Mar. Ser.* vol. 3, Pergamon, New York, xvii + 253 pp., 1980.

Reviewed by L. K. Coachman

This book is a very nice elementary description of the hydrography of the World Ocean (the unity of the oceans is emphasized). Hydrography is used in its classical sense: the observed distributions of temperature, salinity, and density. Distributions of other properties are not included, though occasionally oxygen concentration is mentioned as an aid in interpretation (e.g., as a corroboration of the time a water mass has been removed from the surface). There are no equations and hence no heat and salt budgets. Though current speeds and transport values are given, water budgets derived from these are only implicit. The roles of advection and mixing in creating the hydrographic distributions are introduced solely in a qualitative way. In short, this book is, as the title says, a description of World Ocean hydrography. But it is more than that. The description is included within a discussion of the ocean basin form and topography, wind systems, climatology, and even (briefly) sediment distributions. Thus, the reader can be informed on not only what the ocean looks like, but why, qualitatively, it looks as it does.

The World Ocean is described in four main parts: the Southern Ocean, followed by the Atlantic, Indian, and Pacific in order. The description of each region follows the plan: (1) form, dimensions, location; (2) topography, sediments; (3) atmospheric pressure, winds, basic climatology; (4) general surface circulation; and (5) hydrology—distribution of *S* and *T*, structure and water masses, origin and formation of water masses, movements of water masses, and relation to other oceans.

At the beginning are three short chapters containing basic concepts of the morphology of the earth and ocean basins, physical and chemical characteristics of seawater, and the distribution of T, S, and density. Throughout, most points are illustrated by appropriate horizontal or vertical sections, charts, and graphs, and 19 separate plates are clear pictorials of pertinent features such as general circulation, summer and winter surface temperatures, prevailing winds, precipitation, etc. Everywhere the author has attempted to stay with the 'big picture,' avoiding the finer scales of temporal and spatial variability so dominant in the results of physical oceanographic descriptive study of recent decades. The approach is definitely classical, in the manner of Schott, Sverdrup, and Dietrich.

The book was developed from lectures at the University of Paris for beginning students in a general oceanography course. In Tchernia's words, '. . . it quickly became apparent that the students, whether physicists, biologists, chemists, or geologists, had only the most fragmentary knowledge of the oceans . . .'; in my words, they were oceanogeographically illiterate. This is true of students coming into most oceanographic curricula everywhere. But what frequently happens is the students all too rapidly become involved in the myriad details of their specialty and never do get a feeling for the geography of the World Ocean. Thus, I perceive this book to be a very useful contribution to the suite of oceanographic textbooks. It could be used as a primary text in the first course for all oceanography majors, regardless of specialty. It would not be the sole text, as some amplification is necessary to provide a satisfactory introduction. For example, though TS analysis is employed in the water mass descriptions, the concepts of TS analysis are not discussed.

The book is well produced, the type and figures are clear, and the flexicover edition I have seems well bound. The translation (from French) is excellent. Typographical errors are few and far between, some of which derive from the translation, but none I spotted inhibited understanding. I commend this work to all those engaged in teaching future oceanographers, to the extent of perhaps even influencing the ordering of the subject matter in their present curricula. It will also serve well anyone who wishes a concise overview of the hydrography of the World Ocean.

L. K. Coachman is with the Department of Oceanography, University of Washington, Seattle, Washington.

Classified

Geophysicist: North Carolina State University—Raleigh. The Department of Marine Earth and Atmospheric Sciences is reopening the search to fill a presently available tenure track position in geophysics. Rank is at the Assistant or Associate professor level. A Ph D is required.

Primary responsibilities will include generating and conducting research programs as well as teaching graduate courses in geophysics. The department currently consists of 31 regular faculty members including 16 in the areas of geology and geophysics. Please send resume and names of three references to J. L. Langfelder, Head, Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, Raleigh, NC 27650. Deadline for receipt of applications is December 1, 1981.

North Carolina State University is an equal opportunity affirmative action employer.

University of California, Santa Barbara/Assistant Professor of Geography. Tenure track position available July 1, 1982. Ph D. required prior to appointment. Strong commitment to research and teaching and good background in computer and mathematical quantitative skills required. Major area of specialization should be cartography with other research and teaching interests in human geography. Submit resume, bibliography, and names of three referees to: Dr. Reginald G. Golledge, Chairman, Department of Geography, University of California, Santa Barbara, CA 93106. Closing date: December 31, 1981.

Equal opportunity/affirmative action employer.

University of New Orleans/Geophysicist. Applications are invited for a permanent faculty position commencing August 1982, in exploration geophysics. The Ph D. or equivalent experience is required.

Appointee will be expected to teach graduate and undergraduate courses in geophysics and general geology, conduct a program of research, supervise theses and oversee a program in geophysics. The position will be at the assistant professor level or higher depending on background. Applications are encouraged from individuals with industrial experience, including recent retirees.

Applicants should send a letter outlining interest in position, complete résumé, and three letters of recommendation to Dr. Gordon Frey, Department of Earth Sciences, Lake Front, University of New Orleans, New Orleans, LA 70122.

UNO is an equal opportunity/affirmative-action employer. Applications from minority groups are specifically invited.

University of Hawaii Faculty Positions. The Department of Geology and Geophysics and the Hawaii Institute of Geophysics have openings for the 1981–1982 academic year. Rank is open dependent on qualifications. We are seeking persons who will participate in our teaching and research program in any of the following areas: (1) structural geology and marine tectonics, (2) hydrology and engineering geology, (3) marine seismology, magnetics, and gravity. To apply send a letter of interest, a current vita and 3 letters of reference to Dr S. O. Schlanger, Chairman, Department of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, Hawaii 96822 (808-948-7826), or Dr. C. E. Helsley, Director, Hawaii Institute of Geophysics, same address (808-948-8760). Open until filled.

The University of Hawaii is an affirmative action and equal opportunity employer.

Faculty Position: Environmental Engineering. Beginning January or September 1982. The position requires undergraduate and graduate teaching and sponsored research activities in the areas of water quality control and water resources. An earned doctorate is required and at least one degree in civil engineering is preferred. Rank will be at the assistant professor level and salary will depend upon qualifications. Apply to: Dr. Lester A. Hoel, Chairman, Department of Civil Engineering, University of Virginia, Charlottesville, Virginia 22901.

An affirmative action equal opportunity employer.

Faculty Positions in Earth Science: Syracuse University. The Department of Geology invites applications for four tenure track positions at the level of assistant professor to be filled after January 1982. Outstanding applicants from all areas of earth science will be considered. Candidates specializing in low-T aqueous geochemistry, structure tectonics, solid-earth geophysics, or chemical sedimentology are particularly welcome. Send letter of application including vita, statement of research and teaching interests, and names of 3 references to John Dickey, Chairman, Department of Geology, Heroy Geology Laboratory, Syracuse University, Syracuse, NY 13210. Applications will be accepted until these positions are filled.

Syracuse University is an equal opportunity/affirmative action employer.

City University of New York, (Brooklyn College): Faculty Positions. The Department of Geology anticipates filling several tenure track positions at Full Professor level. (Salary range up to $43,400). Highly qualified individuals will be considered for distinguished appointments at an additional $5,000.

While candidates who have distinguished themselves in any field are welcome to contact us, we are particularly interested in openings in: energy resources (coal-petroleum), exploration geophysics, environmental geology or hydrogeology, coastal sedimentology, economic geology.

Successful applicants will be required to institute an active research program, supervise Master's and Ph.D. theses. Nominations and applications with current vitae should be sent to: Dr. S. Bhattacharji, Chairman, Dept. of Geology, Brooklyn College of City University of New York, Brooklyn, New York 11210. Positions open until filled.

Brooklyn College, CUNY, is an affirmative action/equal opportunity employer.

Research Position in Chemical Oceanography. California Institute of Technology, Division of Geological and Planetary Sciences. The position of research fellow is being offered at Caltech for research in oceanography. Investigation of the isotopic composition of neodymium and rare earth abundances in sea water and sediments is now being carried forward. The mechanism of injection of REE into sea water will be studied. The differences in $^{143}Nd/^{144}Nd$ in various water masses [Piepgras *et al.*, Earth and Planet Sci. Lett. *45*, 223–236 and Piepgras and Wasserburg, Earth and Planet. Sci. Lett *50*, 128–138 (1980)] is now being carried forward as an exploratory venture in order to determine the origin and chemical behavior of REE in the ocean and the potential use of $^{143}Nd/^{144}Nd$ as a tracer. The laboratory facilities for sample preparation and analysis are fully functional and will be available. Applicants should have training in oceanography and a good perspective on general physical oceanographic models.

Send resume and references to Professor G. J. Wasserburg, Lunatic Asylum, California Institute of Technology, Pasadena, CA 91125.

Caltech is an equal opportunity/affirmative action employer (M/F/H).

Assistant Professor/Department of Geology, University of Vermont. The Geology Department at the University of Vermont is recruiting for a tenure track position at the assistant professor level to begin September 1982. Field of specialization should complement existing faculty expertise in petrology, structure and regional geology. Applications are solicited in, but not restricted to, geophysics, igneous petrology geochronology, hydrology/Pleistocene or economic geology. The successful candidate will be expected to develop a research program involving both graduate students (M.S.) and advanced undergraduates. Applications will be accepted until December 1981.

Candidates should send resume and arrange for three letters of reference to be sent to:

Dr. John C. Drake
Acting Chairman
Department of Geology
University of Vermont
Burlington, VT 05405

The University of Vermont is an equal opportunity affirmative action employer.

EARTH SCIENCES

The Lamont-Doherty Geological Observatory of Columbia University invites scientists interested in any field of the earth sciences to apply for the following fellowships: two postdoctoral fellowships, each awarded for a period of one year (extendable to two years in special instances) beginning in September 1982 with a stipend of $22,500 per annum. Completed applications are to be returned by January 15, 1982. Application forms may be obtained by writing to the Director, Lamont-Doherty Geological Observatory, Palisades, New York 10964. Award announcements will be made February 28, 1982 or shortly thereafter.
The Observatory also welcomes applications from candidates for postdoctoral research associate positions in this discipline.

Space Physics Research Position. Applicants with background in interplanetary space, auroral and magnetospheric research, and/or space instrumentation are sought. Successful candidates will work with ISEE particle data and/or with auroral X-ray imaging research that uses the newly developed X-ray cameras. These positions have not been filled and are available now. Send your resumé to Professor George K. Parks, Space Sciences, Geophysics Program, University of Washington, Seattle, WA 98195.

The University is an equal opportunity employer.

Senior Faculty Position: Meteorology. Applications and nominations are invited for a senior faculty position in meteorology, at the University of Utah. Eligible applicant will also be considered for chairperson of the department. Candidates must possess a Ph.D. in meteorology or a related discipline. Applicants should have teaching and research experience and be interested in participating in both the graduate and undergraduate programs. Applicants should submit curriculum vitae and names of three professional references to:

Dr. Jan Paegle
Search Committee
Department of Meteorology
University of Utah
Salt Lake City, Utah 84112

Deadline for applications November 30, 1981.

The University of Utah is an affirmative action/equal opportunity employer.

Atmospheric Scientist/Group Head. Senior staff scientist position available immediately at the NAIC's Arecibo Observatory. The successful applicant will be appointed as Head of the Atmospheric Sciences Group and will be expected to lead that group and to perform independent research using the Arecibo facilities. A Ph.D. degree in atmospheric or physical sciences or radar engineering and a record of solid research accomplishments are required. Experience with radar studies of the stratosphere, mesosphere, and ionosphere or with HF modifications of the ionosphere is desirable. Salary open. Please send resume and names of at least three references to Dr. Harold D. Craft, Jr., Acting Director, NAIC Observatory, Space Sciences Building, Cornell University, Ithaca, New York 14853.

NAIC/Cornell University are EOE/AAE.

California Space Institute, University of California, Santa Barbara: Research position in Remote Sensing. Basic and applied research in some combination of remote sensing of coastal zones, land use/land cover, natural and agricultural vegetation, and soil moisture with skills in information systems, automated image analysis, and quantitative modelling. We seek an independent worker with the goal of deepening and widening existing work in these areas on this campus. Ph.D. preferred. Rank and salary commensurate with experience. Closing date: November 30, 1981. Submit: resume; a brief account of research interests; and names of three professional referees to Dr. David S. Simonett, Department of Geography, University of California, Santa Barbara, California, 93106.

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STUDENT OPPORTUNITIES

Graduate Study in Space Physics and Astronomy. Rice University is pleased to offer Fellowships for entering graduate students in the Department of Space Physics and Astronomy. Exciting research is underway in the fields of theoretical and experimental space plasma physics, magnetospheres of the earth and planets, atmospheric and ionospheric physics, laboratory studies of Rydberg atoms, laser research, space solar power studies, and astronomy and astrophysics.

The fellowships for first year students presently are $4545 taxfree for 9 months, plus tuition, and involve only 4–5 hours tutoring, grading, or instructing per week for four semesters. Research assistanceships for summers and subsequent years are generally available at $550 per month. Students with exceptional undergraduate records and GRE scores are eligible for an additional $1000 Presidential Recognition Award. Raises are expected for next year.

Address inquiries to: Dr. Patricia Reiff, Assistant Chairman, Department of Space Physics and Astronomy, Rice University, 77001.

Research Assistantship in the Study of Annual Ice Covers. Research assistantship(s) for graduate study leading to the M.S. and for Ph.D. degrees with emphasis on the study of the growth and decay of annual ice covers may be available. Hydrological, geophysical or engineering aspects of annual ice covers may be topics of research. Students with backgrounds in physics, mathematics, hydrology, hydraulics, and engineering are desired. For further details, contact Professor T. E. Osterkamp, Geophysical Institute, University of Alaska, Elvey Bldg., 903 Koyukuk Ave., North, Fairbanks, AK., 99701 (Tel. 907-479-7548).

Permafrost Geophysics Assistantships. Research assistantships for graduate study leading to the M.S. and for Ph.D. degrees in the area of permafrost geophysics may be available. Students with backgrounds in physics, soil physics, mathematics, geophysics, geology or engineering are desired. Field work may be required. Possible study topics include virtually all aspects of permafrost geophysics research from detection and mapping to physical properties. For more information, contact Professor T. E. Osterkamp, Geophysical Institute, University of Alaska, Elvey Bldg., 903 Koyukuk Ave., North, Fairbanks, Alaska, 99701 (Tel. 907-479-7548).

Chemical Oceanography Assistantships. Several research assistantships for graduate students in chemical oceanography are available from the School of Oceanography, Oregon State University. Research topics may cover analytical, descriptive, inorganic, organic, physical, geo-, and radiochemistry and radioecology. Beginning master's students are offered $546 a month plus tuition and beginning PhD students are offered $584 a month plus tuition. Students with undergraduate or graduate training in chemistry, chemical engineering, and oceanography are encouraged to apply. Additional information may be obtained from the Student Advisor (503-754-3504) School of Oceanography, Oregon State University, Corvallis OR 97331.

Meetings

Yosemite Conference on Magnetospheres

Preliminary abstracts for the 1982 Yosemite Conference entitled 'Origins of Plasmas and Electric Fields in the Earth's Magnetosphere' are due October 31. The conference is scheduled for January 25–29, 1982, at The Ahwahnee in Yosemite, Calif. Extended abstracts (four pages maximum length, including figures) are due November 30.

The conference will address the nature of plasma sources and electric field generators within the magnetosphere. Sources of magnetospheric plasma will be discussed in context of the solar wind, plasmasphere, and ionosphere boundary source regions. In addition, the generators of the magnetospheric electric field will be treated in two parts: the dynamo aspects of generating an electric field in the solar wind/magnetosphere system and the effect of the overall coupling between ionosphere, plasmasphere, and magnetosphere on the generators.

For additional information about the conference, write either of the convenors, F. T. Berkey or J. C. Foster, CASS, UMC 34, Utah State University, Logan, UT 84322. Berkey's telephone number is 801/750-2981; Foster's is 801/750-2966.

The conference is sponsored by the Solar Terrestrial Division of NASA, Utah State University, and AGU.

Earthquake Engineering Conference

The Eighth World Conference on Earthquake Engineering is scheduled for July 21–28, 1984, at the Fairmont Hotel in San Francisco, Calif. The conference will be a forum for scientists in all fields related to earthquake engineering. Conference topics probably will include geoscience, civil and structural engineering, planning and regulations, and social and economic aspects of earthquake engineering.

The conference is sponsored by the Earthquake Engineering Research Institute (EERI).

For details on how to submit an abstract and register for the meeting, or to obtain other information, contact R. B. Matthiesen, Chair-8WCEE, EERI, 2620 Telegraph Avenue, Berkeley, CA 94704.

ANTON L. HALES SYMPOSIUM

The Geosciences Program of The University of Texas at Dallas will sponsor a Symposium entitled

"SOME RECENT ADVANCES IN GEOPHYSICS"

on October 5–6, 1981, in honor of Dr. Anton L. Hales on his 70th birthday.

The Symposium will consist of two days of invited talks by internationally known speakers from academia and industry on recent developments in geophysics with an emphasis on seismology. Topics will include recent COCORP results, modelling reflection seismograms, heterogeneous earth structure, attenuation of seismic waves, and global tectonics.

For additional details and registration information, contact Richard M. Mitterer or Ronald W. Ward, Programs in Geosciences, The University of Texas at Dallas, P.O. Box 688, Richardson, Texas 75080. Telephone: 214-690-2401.

1981 Midwest Meeting
Plan to Attend

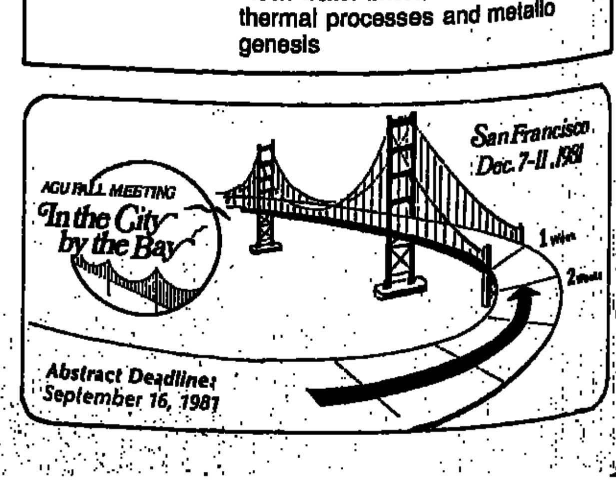
September 17–18
Minneapolis, Minnesota

Radisson Hotel (Rates: Single $34, Double $40, Triple $12.50 per person)

Special Sessions:

Thursday
- Mantle structure and dynamics
- Hydrology in the mid-continental U.S.

Friday
- Precambrian crustal evolution of the North American continent
- Sedimentary paleomagnetism: Geological history from the recent to the Precambrian
- Rock water interactions: Hydrothermal processes and metallo genesis



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Oceanography

4707 Boundary layer and exchange processes
OCEAN FRONTAL FORMATION DUE TO SHALLOW WATER COOLING EFFECTS AS OBSERVED BY SATELLITE AND SIMULATED BY A NUMERICAL MODEL
F. W. Garwood, Jr. (Dept. of Oceanography, Naval Postgraduate School, Monterey, CA 93940) [illegible]

[illegible]

J. Geophys. Res., Green, Paper 1C1186

4708 Boundary layer and exchange processes
[illegible]

boundary layer. The power spectra of U and W have pronounced maxima at the frequency of the wave spectral peak. However, these wave induced components support little Reynolds stress owing to the phase difference of 90° between U and W. Abrupt generation of large Reynolds stresses is intermittently observed in the time series of U(t) x W(t). They occur at windward or leeward points close to the crests, indicating their close connection with the wind waves. [illegible] (Turbulent boundary layer, Wind waves, Wind wave tunnel, Bursting) Sci. Rep. Tôhoku Univ., Ser. 5 (Tôhoku Geophys. Journ.), Vol. 28, No. 1, 1981

4710 Chemical oceanography
DISTRIBUTION OF HYDROTHERMAL MANGANESE OVER THE JUAN DE FUCA RIDGE
C. J. Jones, [illegible] (Dept. of Oceanography, University of Washington, Seattle, Washington 98195)
Bottom waters from five hydrographic stations, spaced equally along a 500-km section of the Juan de Fuca Ridge north of the Blanco Fracture Zone, contain anomalously high concentrations of Total Dissolvable Manganese (TDM). [illegible] Analysis implies that hydrothermal activity along the ridge axis is contributing substantially to the manganese content of the water column in this portion of the northeastern Pacific.
Geophys. Res. Lett., Paper 1L1074

4713 Circulation
AN ESTIMATE OF ABSOLUTE GEOSTROPHIC VELOCITY FROM THE DENSITY FIELD IN THE NORTHEASTERN PACIFIC OCEAN
D. Coats (Scripps Institution of Oceanography, La Jolla, Calif., 92093)
A pair of hydrographic sections were analyzed to compute absolute velocity by using a variation of the technique advanced by Stommel and Schott (1977). Absolute velocity is determined from an integrated form of the potential vorticity equation by a technique suggested by Davis (1978). [illegible]
J. Geophys. Res., Green, Paper 1C1092

4715 Circulation
[illegible]
[illegible] by the theory. Ekman depth, and thus the vertical coefficient of eddy viscosity, can be determined from hydrographic data describing an intrusion. (Shelf edge front, intrusions, dynamics).
J. Geophys. Res., Green, Paper 1C1131

Oceanology
Volume 20, Number 5

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4765 Surface waves, tides, and sea level
EXPERIMENTAL STUDY ON STRONG INTERACTION BETWEEN REGULAR WAVES AND WIND WAVES—II
Y. Imai (Geophysical Institute, Faculty of Science, Tôhoku University, Sendai 980, Japan) H. Katori, H. Tokuda and Y. Toba
Experiments on evolution of a wave field, when the wind blows over a train of mechanically generated regular wave, have been performed in a wind-wave tunnel. Among four stages of the evolution already described in the preceding paper [illegible]
(Water waves, wind waves, wind-wave tunnel, nonlinear interaction)
Sci. Rep. Tôhoku Univ., Ser. 5 (Tôhoku Geophys. Journ.), Vol. 28, No. 1, 1981

Izvestiya Atmospheric and Oceanic Physics
Volume 16, Number 11

CONTENTS

[illegible] It is also concluded from the phase space density studies that "fresh" particles with magnetic moments up to at least several hundred MeV/gauss were injected near geostationary orbit. The present adiabatic convection model can explain the observed injection of large magnetic moment particles from the plasma sheet in to synchronous orbit although physical elements of the normal model must be altered somewhat.
J. Geophys. Res., Blue, Paper 1A1125

5780 Wave Propagation
PRESERVED SIGNATURES OF ION FLUX MODULATIONS OBSERVED BY ATS-6
S-T Su (Lockheed Engineering and Management Services Co., Inc., Houston, TX 77058) A. Konradi and T. A. Fritz
On August 13, 1974 the ATS-6 NOAA instrument in geostationary orbit observed oscillation a few hours after local midnight in the fluxes of ions from 24 keV to 150 keV (five channels) [illegible]
J. Geophys. Res., Blue, Paper 1A1183

Particles and Fields—Magnetosphere

5775 Trapped particles
OBSERVATION AND MODELING OF ENERGETIC PARTICLES AT SYNCHRONOUS ORBIT ON JULY 29, 1977
D. N. Baker (Los Alamos National Laboratory, Los Alamos, NM 87545), [illegible] Higbie, [illegible] W. Stiltmann, [illegible] Vampola
In the twelve hours following a worldwide storm sudden commencement at 0027 UT on 29 July, there was a series of at least four magnetospheric substorms [illegible]

5780 Wave propagation
[illegible]